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ENGINE PERFORMANCE AND EMISSION CHARACTERISTICS OF 1-OCTANOL BLENDED BIO-DIESEL IN A SINGLE CYLINDER DIESEL ENGINE

V.SRIRAM, JEYAJEEVAHAN, G.MAGESHWARAN, G.BRITTOJOSEPH & R.B.DURAIRAJ

Department. of Mechanical Engineering, Sathyabama University, Chennai, Tamilnadu, India

ABSTRACT

Experiments were carried out on a diesel engine operating on diesel, bio-diesel and bio-diesel blended with 1-octanol. The blended fuels are prepared with 10%, 20%, and 30% of 1-octanolby volume. The experiments were conducted in a single cylinder C. I engine under five engine load conditions at a speed of 1500 rpm. The engine performance and emission characteristics were determined and compared. The results shows that the blending of 1-octanol seen to be a promising alternative additive with bio-diesel for improving emission characteristics and engine performance.

KEYWORDS: Biodiesel, C.I engine, Additive & 1-Octanol

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Original Article

NOTATIONS USED

NOx- Nitrous oxide

RPM- Revolutions Per Minute

FSN- Filter Smoke Number

BTE- Brake Thermal Efficiency

BMEP- Brake Mean Effective Pressure

BSFC- Brake Specific Fuel Consumption

Kpa- Kilo pascal

Kg/Kwh- Kilogram per kilowatt hour

PPM- Parts Per Million

CO- Carbon monoxide

^{o}C- Degree centigrade

INTRODUCTION

The paper reviews the status of fat and oil derived diesel fuels. The fuels considered are primarily the methyl esters of fatty acids derived from a variety of vegetable oils and animal fats, and referred to as biodiesel. The economics of biodiesel production are discussed, and it is concluded that the price of the feedstock fat or oil is the major factor [9]. Emissions of NOx, increase significantly, for both neat and blended fuels in both two- and

four-stroke engines [8]. Since the prices of edible vegetable oils are higher than that of diesel fuel, therefore waste vegetable oils and non-edible crude vegetable oils are preferred as potential low priced Biodiesel sources. Using such type of edible oil for the production of biodiesel in India, is also not easy in view of big gap in demand and supply of such oils determining biodiesel price [10]. The exhaust gas recirculation has a main impact on the emission and combustion characteristics of the engine [1]. The emission of NOx increases with the ethanol present in the blend [2]. When operating tractor with 100% sunflower oil instead of diesel fuel, an 8% power loss occurred after 1000 h of operation, which was corrected by replacing the fuel injector, and injector pump [11]. The isobutanol derived from the waste vegetable oil for different blends have different emission characteristics [12, 14].

MATERIALS AND METHODS

Fuels Used

1-octanol is used as fuel which is having a purity percentage of nearly 99 percent and the impurity may be 1%. The 1-octanol is blended with the diesel for three different proportions such as 10%,20%,30% respectively.

Engine Specifications

Test was performed on a conducted on a single cylinder, four stroke, constant speed diesel engine operating under normal atmospheric conditions.

Make and model	Kirloskar, TAF1 make
Number of cylinders	1
Combustion chamber	Hemispherical open type
Piston	Bowl-in type
Bore, mm	87.5
Stroke, mm	110
Connecting rod length, mm	220
Swept volume, cm3	661
Clearance volume, cm3	36.87
Compression ratio	16.5:1
Rated power, KW	4.2
Rated speed, rpm	1200

The test was conducted under the constant speed condition at normal atmospheric temperature. All the set of readings are repeated on the same day of the experiment. The engine is first made to run with the diesel without any blend for taking the base line values of reference. Later the engine was supplied with the blended biodiesel of different composition at each run as shown in figure.1.

Figure 1: Experimental Setup

RESULTS AND DISCUSSIONS

By conducting an experiment at constant speed diesel engine with diesel blended with different percentage of 1-octanol it is noted that the emission of NOx is increased with the blends, as shown in figure.2. The emission of NOx can be controlled, by adding cetane improvers with diesel [2].

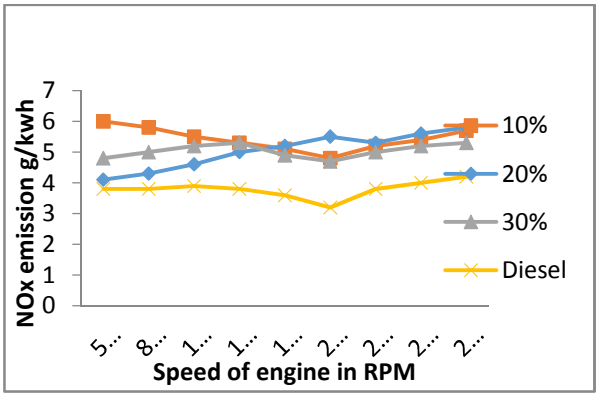

Figure 2: Noxemission

Figure. 3, shows the smoke emission values for the biodiesel blends are less than the mineral diesel and smoke emission decreases, with the increase in the value of blending of biodiesel, due to the poor combustion of the ethanol content present in the mixture [3].

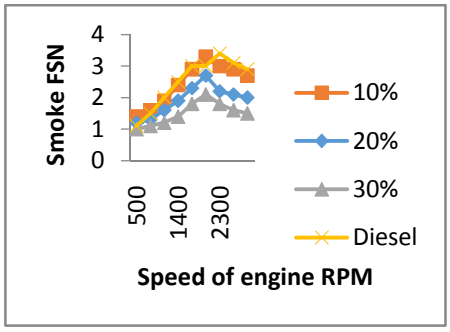

Figure 3: Smoke Emissions

The brake thermal efficiency increases with the increase in the percentage of 1-octanol blend with diesel as in figure.4. The main reason for the improvement in the efficiency is due to the increase in the percent of oxygen in the blend. The percentage of brake thermal efficiency initially increases with the mean effective pressure [1].

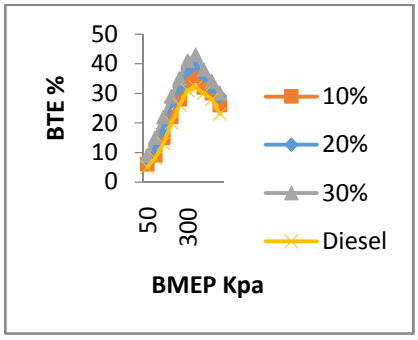

Figure 4: BTE for Various Blends

The variations in the brake specific fuel consumption as a function of engine load for the different biodiesel blends running under normal atmospheric condition have been shown in the figure. Figure.5 shows the calorific values of the different blends are nearly equal to the diesel. The fuel consumption decreases with the increase in the value of octane content in the blending mixture.

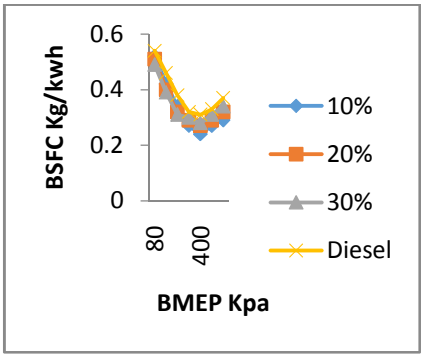

Figure 5: BSFC for Various Blends

The exhaust gas temperature shows the proportion of the air-fuel mixture in the blends [4]. The figure below shows the exhaust gas temperature variations for the corresponding engine loads, figure. 6 clearly depicts that the exhaust gas temperature and the 1-octanolin the diesel blend and the thermal efficiency increases with the addition of 1-octanol. The exhaust gas temperature increases with the exhaust gas recirculation [5].

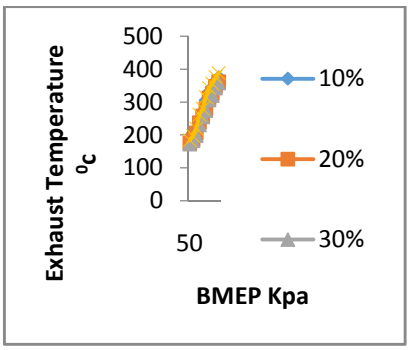

Figure 6: Exhaust Temperature Variations for Different Blends

The figure.7shows that the hydrocarbon emission reduces with increasing in the percentage of 1-octanol due to the increased efficiency in combustion [6]. Hydro carbon emission also occurs due to the settle down of partially combusted fuels inside the combustion chamber [5]. The hydrocarbon emission reduces with increase in the 1-octanol/ diesel blends

[7].

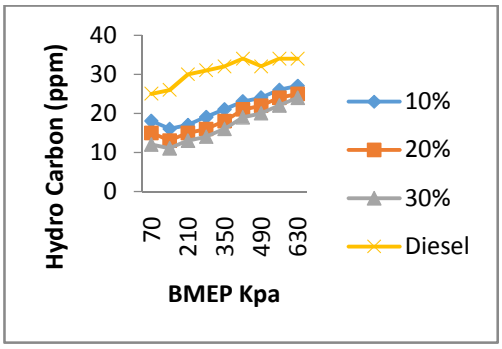

Figure 7: Hydrocarbon Emission Variations for Different Blends

Carbon monoxide emission indicates that a part of the energy have been lost, like hydrocarbon emission [8,13]. The figure below also clearly explains the reduction in carbon monoxide in volume for the corresponding increase in the brake mean effective pressure as in figure.8.

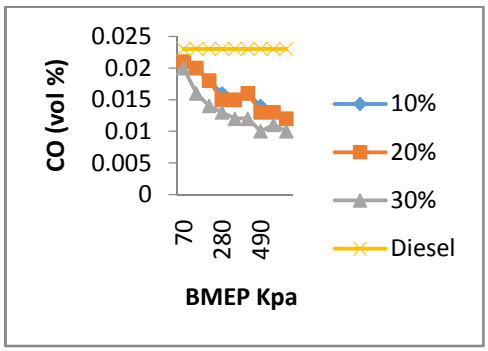

Figure 8: Carbon Monoxide Emission for Various Blends

NOx emissions of the blended fuels and diesel, shown in the figure 9. The NOx emissions of 1-octanol biodiesel blend are lower for all load conditions, as compared to that of diesel. The cooling effect of 1-octanol, due to its higher latent heat of vaporization reduces the combustion temperature, so that NOx emissions produced by 1-octanol blends are reduced. Higher cetane number and lower oxygen content also influenced NOx reduction.

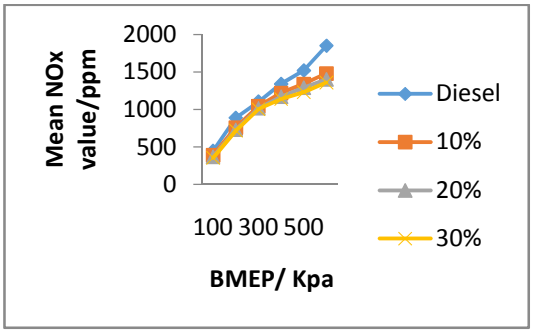

Figure 9: Nox Emission Comparison for Diesel With Different Blends

CONCLUSIONS

The effect of 1-octanol blends with diesel on the combustion, performance and emissions of single cylinder diesel engine is analyzed, and the various percent of composition has been compared with the diesel fuel, from the values it is

observed that the brake specific fuel consumption decreases and while in terms of the brake thermal energy increases with the increase in the percent of blend. Then in terms of the emissions consideration the harmful gas such as nitrous oxides, carbon monoxide, and hydrocarbon values are reduced with increase in 1-octanol blend, which makes the 1-octanol as a best biofuel that can be used in diesel engine.

REFERENCE

1. *Chen Z, Wu Z, Liu J, Lee C. Combustion and emissions characteristics of high n-butanol/diesel ratio blend in a heavy-duty diesel engine and EGR impact. Energy Convers Manage 2014;78:787–95. http://dx.doi.org/10.1016/j. enconman.2013.11.037.*
2. *Sinha S, Agarwal AK. Performance evaluation of a biodiesel (rice bran oil methyl ester) fueled transport diesel engines, SAE 2005-01-1730; 2005. p. 1–9.*
3. *McCormick RL, Tennant CJ. Regulated emissions from biodiesel tested in heavy-duty engines meeting 2004 emission standards, SAE Technical Paper No. 2005-01-2200; 2005.*
4. *Saleh HE. Experimental study on diesel engine nitrogen oxide reduction running with jojoba methyl ester by exhaust gas recirculation. Fuel 2009; 88 (8):1357–64. http://dx.doi.org/10.1016/j.fuel.2009.01.023.*
5. *Rakopoulos DC, Rakopoulos CD, Giakoumis EG, Dimaratos AM, Kyritsis DC. Effects of butanol–diesel fuel blends on the performance and emissions of a high-speed DI diesel engine. Energy Convers Manage 2010;51(10):1989–97. http://dx.doi.org/10.1016/j.enconman.2010.02.032.*
6. *Deep A, Kumar N, Karnwal A, Gupta D, Vibhanshu V, Sharma A, et al. Assessment of the performance and emission characteristics of 1-octanol/diesel fuel blends in a water cooled compression ignition engine. SAE Technical Paper # 2014-01-2830; 2014. http://dx.doi.org/10.4271/2014-01-2830.*
7. *Rajesh Kumar B, Saravanan S. Effect of exhaust gas recirculation (EGR) on performance and emissions of a constant speed DI diesel engine fueled with pentanol/diesel blends. Fuel 2015;160:217–26. http://dx.doi.org/10.1016/ j.fuel.2015.07.089.*
8. *Sriram, V. Jeevahan, J. Poovannan, A.Comparative study of performance of the DI diesel engine using custard apple biodiesel, International Journal of Ambient Energy,issn: 21628246 01430750, 2017.Pp 1-3.*
9. *Graboski, M. S. and McCormick, R. L. frog , "Combustion of fat and vegetable oil derived fuels in diesel engines', Energy Combust. Sci., 1998, 24, (2), 125-164.*
10. *Fangrui Ma, Hanna Milford A. Biodiesel production: a review. BioresourTechnol 1999;7:01–15.*
11. *Yarbrough C.M., Lapori W.A., Engler C.R. Compression ignition performance using sunflower seed oil. ASAE paper number 81–576. St.Joseph,MI: ASAE; 1981.*
12. *Shivaji, Kailash B Anwar & S. Gowreesh, Experimental Investigation on Use of Preheated Pongamia Oil Bio-Diesel in DI Diesel Engine, International Journal of Automobile Engineering Research and Development (IJAuERD), Volume 4, Issue 6, November - December 2014, pp. 1-6*
13. *Jeevahan, J.,Chandrasekaran, M.,BrittoJoseph,G.,Poovannan,A.,Sriram,V"Experimental investigation of the influence of isobutanol addition on engine performance and emissions of a direct ignition diesel engine fuelled by biodiesel blends derived from waste vegetable oil" ,"International Journal of Ambient Energy" 2017, pp 1-8.*
14. *JeyaJeevahan, G. Mageshwaran, G. Britto Joseph, R. B. Durai Raj & R. ThamaraiKannan (2017) Various strategies for reducing Nox emissions of biodiesel fuel used in conventional diesel engines: A review, Chemical Engineering Communications, 204:10, 1202-1223, DOI: 10.1080/00986445.2017.1353500.*

15. *Mani Kunjan, JeyaJeevahan, Britto Joseph, Mageshwaran G, Durai Raj RB, Poovannan A, "Biodiesel Derived from Mango Seed Oil as An Alternative Fuel for Diesel", Research Journal of Pharmaceutical, Biological and Chemical sciences, ISSN: 0975-8585, November – December 2016 RJPBCS 7(6) Page No. 2137.*